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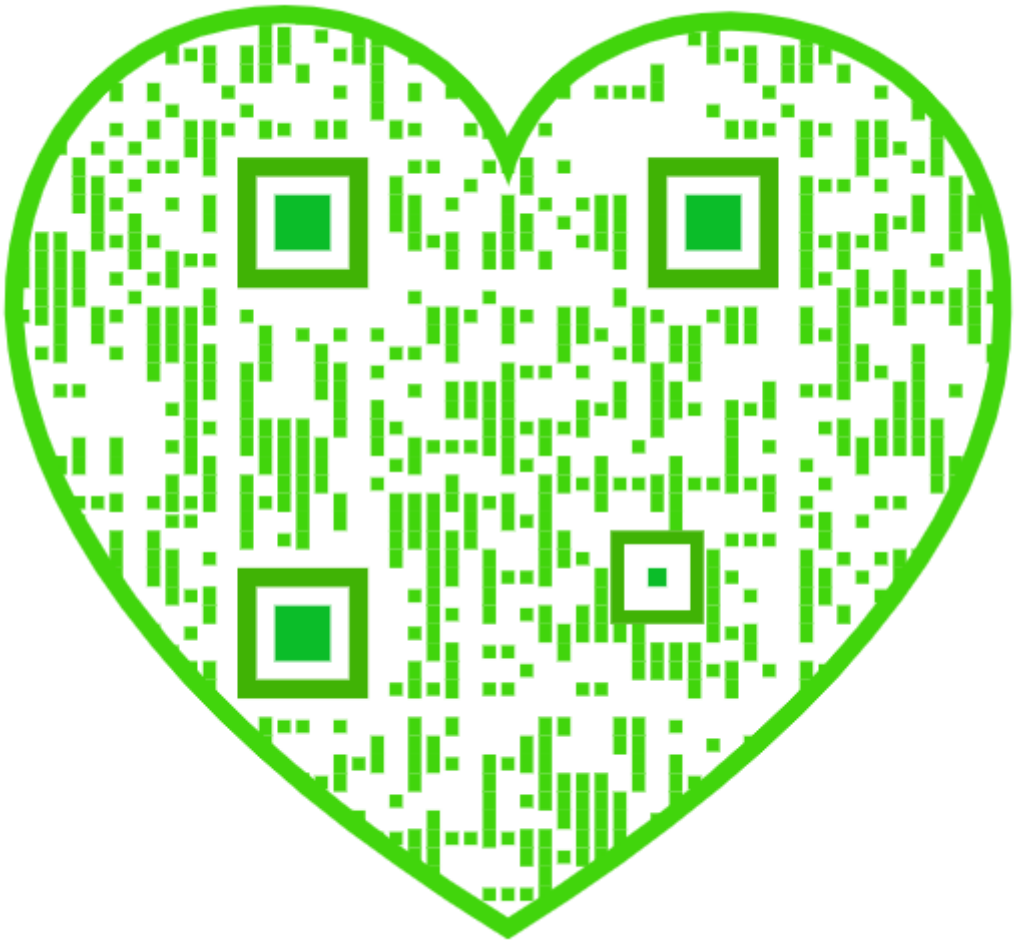

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U.S. National Museum

ON THE

STRUCTURE AND AFFINITIES OF THE COMPOSITE BOW.

BY

HENRY BALFOUR, M.A., F.Z.S.

WITH PLATES V AND VI.

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On the Structure *and* Affinities *of the* Composite Bow.

By Henry Balfour, M.A., F.Z.S.

[with plates V and VI.]

Considerable attention has been paid to the history of the bow by General Pitt Rivers, who, in his catalogue of his anthropological collection, published in 1877, has given an admirable general account of this weapon, the result of very careful research in a field at that time but little investigated. To him is due the credit of having first pointed out the necessity for dividing the varieties of the Bow into two principal groups called by him the "Plain Bow" and the "Composite Bow" groups respectively. He has entered, moreover, very fully into the question of the geographical distribution of the varieties, and has pointed out how the "Composite Bow," the offspring of necessity, originated as a copy of the "Plain Bow," in regions where suitable materials for the latter were not available. The series of specimens illustrative of this subject in the Pitt Rivers' collection, lately presented to the University of Oxford, is a very representative one, and in working at this series during the arrangement of the collection in the Oxford Museum, I was tempted to investigate further the structure and affinities of bows of composite nature.

Apart from the writings of General Pitt Rivers very little appears to have been written to describe the *complex structural peculiarities* of the higher types of the composite bow, and that little, so far as I have been able to ascertain, is for the most part extremely vague and superficial.[1] This is all the more curious when we consider that this species of bow has been in use in its most highly specialized form for a very considerable time, and has been mentioned by countless writers, both ancient

[1] Mr. J. Murdoch has written a very complete account of the sinew backing of Esquimaux bows ("Annual Report of Smithsonian Insitute," 1884, Pt. II, p. 307). Ascham's "Toxophilus," Hansard's "Book of Archery," and W. Moseley's "Essay on Archery" (1792), give general accounts of bows, but their descriptions are many of them very unreliable and incomplete. The most recent general paper on the subject is D. N. Anuchin's "Bows and Arrows," in the "Transactions of the Tiflis Archæological Congress." Moscow, 1887. 4to. This contains a very interesting general account, illustrated. I am much ndebted to my friend Mr. W. L. Morfill, for very kindly translating that portion which bears specially upon the subject of my paper. I have added notes from this paper in footnotes, as I was unfortunate in not obtaining a copy till my own paper was completed.

and modern. As regards its powers and the skill of Asiatic archers much has been written, and its eulogy has been uttered in the most extravagant terms, and with this I do not purpose to deal, but merely propose to confine myself to a description of the details of the anatomy of the higher types, with mention of some of the more primitive types for comparison, and of some forms allied to the composite bow. I recently had passed on to me by Dr. Tylor the half of a broken Persian bow, of excellent workmanship, and probably of considerable age (perhaps 200 years), which was sent to Oxford with other Persian weapons by Colonel Sir R. Murdoch Smith. This I cut into sections for the purpose of displaying its structure, described below, and this led me to investigate the anatomy of one or two other allied forms by way of comparison.

Before commencing a description of the structure of the more highly specialized forms, it may be well briefly to mention a few points in connection with those forms which shew a more primitive construction, and which may be taken as illustrating, to some extent at least, the stages in the evolution of the highly complex types which complete the series. The distribution of the composite bow is too well known from General Pitt Rivers' writings to need examination here. The more prominent types are those of the Eastern and Western Esquimaux, of some races of North-West America, and the Tatar and Persian forms, there being various offshoots from each of these forms.

In the more northerly regions of Central Asia (where, as pointed out by General Pitt Rivers, it seems likely that, from the lack of suitable wood for long-bow making, the use of a combination of materials for producing bows on the model of the older "self" bow originated), the earlier and more primitive forms have died out. We have therefore to seek elsewhere, in the more barren regions into which this form of bow has extended, for the primitive types which may serve to illustrate the struggles of the early bowyers in their attempts to produce a serviceable weapon.

The most primitive type now existing is that found among the Eastern Esquimaux, consisting of a piece of drift-wood (or two or more pieces of wood, whale-rib, or horn spliced together[1]) "backed" with a cord of plaited or twisted sinews, which is fixed by an eye-loop to one of the nocks of the bow, and is wound up and down between the nocks, passing round them. A bundle of cords is thus formed, stretched tightly between the ends of the bow, and to a great extent covering the "back." Sir Martin Frobisher described this form of sinew backing as

[1] Anuchin mentions the following materials as added to the wood sometimes:—Whalebone, stag (? cariboo) horn, musk ox horn, or walrus tooth.

"not glued to, but fast girded on." Sometimes, even in the roughest specimens, the longitudinal lacing is gathered up into a compact rope by spiral binding. There are further cross lacings passing round the body of the bow and the backing, so as to keep the latter close against the former.

A specimen from the Barrow collection in the British Museum from Whale Fish Island (?) is backed with a lacing of raw hide, gathered into two bundles twisted up, with a cross lacing of the same material. A second in the British Museum from Parker Bay, Victoria Land, consists of roughly spliced bones reinforced at the back with short *whalebone* (baleen) strips. Crantz also mentions this material as used for backing Greenland bows. I have figured (Plate V, Fig. 1) a bow of this simple type obtained from the Eastern Esquimaux by Captain Lyon, R.N., *circa* 1825. In this specimen the body is of a single piece of drift pine, thick and clumsy; the tension of the sinew backing in this, as in most cases, causes the bow to assume the opposite curve to that of the weapon when strung for use. It frequently happens that the bows of the Eastern Esquimaux assume a very unsymmetrical shape, from the rough splicing and the unequal strength of the parts.

When the body is composed of more than one piece of bone, the pieces may be united by being overlapped and fixed with sinew thongs passed through holes, or with rivets of old ships' nails, or by splicing. In the latter case the joints are often strengthened by additional short pieces placed on back and front, with a splicing line bound round the whole.

The Esquimaux bows have been so well described in detail by Mr. John Murdoch[1] that I need not enter into the details of the various modes of "backing" characteristic of the different regions of Arctic North America, my purpose being merely to describe the prominent types which seem to indicate the various epochs in the history of this weapon. Mr. Murdoch refers his three well-defined western types to a single primitive ancestral form, of which the bows of the Eastern Esquimaux with simple backing, such as that described above, are but slightly modified survivals. He cites as an example a bow from Cumberland Gulf of very primitive construction.

In the western regions of the Esquimaux, where the materials are of better quality, and the workmanship far superior, owing no doubt to the ready access to the higher civilization of the West, in the proximity to the Asiatic Continent, the style of backing is more complicated. The cross lacing round the wood, especially, is usually more elaborate; occasionally, as in the specimen figured (Fig. 2), obtained by Capt. Beechey in 1826,

[1] *Op. cit.*

to the N.E. of Icy Cape, forming a close transverse binding over the greater length of the bow, the central grip and two extremities alone remaining free. By this means the longitudinal cords are brought into close contact with the wood, and the whole becomes stronger and far more compact. The backing is wound between the nocks as in the eastern forms, but the strands are gathered up closely to form a compact rope-like bundle, kept close against the body by the transverse binding, except at the ends where the strands are more free and less compactly packed. Generally the sinews are twisted together into a single or double rope by means of small ivory levers.

Many of the Western Esquimaux bows appear not to be of drift wood, but of wood of better quality, though Beechey describes bows from Kotzebue Sound as being of drift pine. He, however, mentions bags of resin "which appeared to be the natural exudation of the pine. From their constantly chewing it, it did not seem difficult to be had." In all probability they have fairly easy access to living trees, and frequently make their bows of the live wood.

Many bows from the western regions of North America have strips of horn, or ivory, or whalebone between the backing and the "body," and occasionally strips of hide are added; the backing is moreover frequently tightened by the insertion of small plugs. The wood is often painted over with various designs, and these bows also often exhibit the shape characterised as the "Tatar" shape, of which the specimen figured (Plate V, Fig. 2) is a good example. The two ends are bent suddenly away from the general line and are straight, the angles or "elbows" being emphasized in the unstrung state.

The close cross binding occurs most frequently at the "elbows," which, when the bow is strung, have to withstand a somewhat severe strain; but, as seen above, in many cases extends more or less towards the central "grip."

The "Tatar" shape is doubtless derived directly from the Asiatic Continent, ready access being afforded by the narrow Behring's Straits. It extends certainly as far as Hudson Straits. Capt. Beechey mentions[1] the close resemblance between bows of St. Lawrence Island, Behring's Straits, and those of the Tchuktschi. He lays stress upon the many points in common to be observed in the two races. Capt. Belcher[2] also points out the connection between the peoples of Arctic Asia and America. He says, "The bows of the Esquimaux are either in one single piece steamed to form, or at times composed of three pieces of

[1] "Narrative of a Voyage to the Pacific and Behring's Straits," 1831, p. 243.

[2] "Trans. Ethnol. Soc.," Vol. i, 1861, p. 129.

drift wood, and it has always appeared to me that their object has been to produce a form very similar to the strung bow of the Tartars, and *totally dissimilar* to the tribes of Indians on the American shores southerly." Dr. King, in his description of the Esquimaux, writes,[1] "The Esquimaux of Behring's Straits bestow much care in giving the bow the proper form, and for this purpose they wrap it in shavings soaked in water, and hold it over a fire for a time; it is then pegged to the earth in the form required. By the assistance of the sinews at the back the bow preserves its elastic power, and by slackening or tightening them it is rendered weak enough for the child or strong enough for the most powerful man, and when fast girded it causes the implement, when unstrung, to turn the wrong way. They have also the power of altering the length of their bowstring to their pleasure by twisting the several strings, often 15 or 20 plaits, of which it is composed. Some of the warlike tribes of Behring's Straits muffle with fur the horns of their bows to deaden the noise of the string against them."

To enumerate the several Esquimaux varieties of what I should propose to call "free" sinew backing (as opposed to the backing of sinews *moulded* on to the wood or horn, which may for convenience be called "close" backing), would be merely to repeat the substance of Mr. Murdoch's paper; and I shall here leave this form and pass to a very distinct type, which may well be regarded as a survival of an early form in the direct line which has led to the perfected Asiatic bows. The peculiarity of this type, which is distributed over a fairly wide area of North-West America, is that, instead of the sinew backing being composed of plaited sinew cords, kept close to the bow by means of cross binding of similar material, it consists of a *mass* of sinews[2] taken from the back or neck of some animal, not divided up into strands or cords, but moistened and then moulded in layers directly on to the surface of the bow, so that the whole forms a very compact weapon, the composite structure being far less obvious than in Esquimaux bows with "free" backing. In making these bows, as Sir E. Belcher tells us, the wet layers of sinew are applied so as to entirely encase the wood: "The horns of the bow are also moulded entirely from it, and, when dry, it presents the translucent features of horn. The face of the bow is then polished off to show the wood. These bows are preserved with the utmost care in fur cases to prevent moisture reaching them, by which their strength would be materially diminished."

[1] "Journ. Ethnol. Soc." Vol. i, p. 293.

[2] Burton mentions bows of the Sioux and Yutas with a backing of *raw hide.* Is it possibly this solid mass of sinews that he has described under this term?

Catlin[1] gives an interesting description of the bows of the Blackfoot tribe (between the Missouri and the Yellowstone, about 34° W, 41° N.), which I quote in his own words: "The length of these bows is about three feet, and sometimes not more than two and a half. They have, no doubt, studied to get the requisite power in the smallest compass possible, as it is more easily and handily used on horseback than one of greater length. The greater number of these bows are made of ash, or of 'bois d'arc' (as the French call it), and lined on the back with buffalo or deer's sinews, which are inseparably attached to them, and give them great elasticity. There are very many also (amongst the Blackfeet and the Crows) which are made of bone, and others of the horns of the mountain sheep. Those made of bone are decidedly the most valuable, and cannot in this country be procured of a good quality short of the price of one or two horses. . . . The bone of which they are made is certainly not the bone of any animal now grazing on the prairies, or in the mountains between this place and the Pacific Ocean; for some of these bows are three feet in length, of a solid piece of bone, and that as close-grained, as hard, as white, and as highly polished as any ivory. . . . It is my opinion, therefore, that the Indians on the Pacific Coast procure the bone from the jaw of the sperm whale, which is often stranded on that coast, and, bringing the bone into the mountains, trade it to the Blackfeet and Crows, who manufacture it into these bows without knowing, any more than we do, from what source it has been procured."

I have figured (Plate V, Fig. 3) a good example of this kind of bow, which was obtained by Capt. Belcher in California, now in the Pitt Rivers collection. In some of the bows of this type the sinew layer is moulded on the back from end to end and bound round at the ends with sinew strands, and sometimes porcupine quills in addition, to prevent its coming away from the surface of the bow; but in others, as, *e.g.*, the Californian bow figured, an advance on this is observed in the sinew layer being moulded so as to enclose completely the last inch or so of both ends, thus doing away with the necessity for binding at the extremities. In these latter forms the sinew extends beyond the ends of the wood or horn body of the bow, and forms solid tips, which are so moulded as to form the nocks. Nearly all are bound round at the centre with thongs of hide, or other material, for the hand grip. In order to give a firm hold to the sinew, the surface of the "back" of these bows is scored over with deep scratches, so as to present a rough surface. A marked recurved outline in the unstrung state is frequently exhibited, from the tension of

[1] "North American Indians," fifth edition, 1845, p. 32.

the sinews, as will be seen from the figure, the curve in this specimen being of a very regular C shape.

This method of backing must have proved a distinct advance upon the presumably older system of "free" backing. This compact and powerful weapon appears to have been especially adapted for use on horseback, as it has been favoured particularly by the horse-riding tribes. It is moreover the form which has been worked up to the state of greatest perfection on the Asiatic Continent. The sinew backing is sometimes reddened, sometimes blackened, or it may be left of its natural colour, as in the one figured. The Ossage and Modoc tribes and many others used this bow, and General Pitt Rivers has stated his belief that "occasionally it is used as far south as Peru."[1]

Of the Esquimaux and North-West American bows, I have described three prominent varieties:—1. That of the Eastern Esquimaux, with its simple backing laced from end to end, roughly made, and presenting a very primitive structure; 2. That of the Western Esquimaux, shewing well-made examples; the backing still of plaited sinew laced between the ends, with, in addition, a more or less complicated system of cross lacing, many of the bows being painted, though in none is the sinew backing concealed beneath an ornamental covering; the shape frequently betraying the influence of the proximity to the Asiatic Continent, in the appearance of the "Tatar" outline; 3. The North-West American form, in which the sinew is moulded closely on to the surface of the bow, and is sometimes painted over, these bows being usually short and very compact.

For the higher forms we must turn to the Asiatic Continent, and I will again only describe the more prominent varieties characteristic of different regions, without going into the details of the numerous subvarieties more than necessary.

The descriptions of bows by the early classic writers are more or less vague, and no mention, so far as I know, is made of sinew "backing," though, from the accounts of the shapes of many varieties, there is little doubt that this kind of reinforcement was in vogue at a very early period. In the Iliad[2] the bow of Pandarus, the Lycian, is described as of mountain goat's horn, without mention of other materials to indicate a composite structure. At the same time the poet ascribes to the bow of Odysseus[3] a prodigious power which is not easily reconciled with the material, plain horn of considerable length (I assume that both these bows are of the same type). The great strength and the effort and knack required for stringing and drawing such

[1] "Catalogue of the Anthropological Collection," 1877, p. 51.
[2] "Iliad," Book iv, 105.
[3] "Odyssey," Book xxi.

bow, is more easily explained by supposing that those from which Homer drew his description were of composite structure, with a powerful reinforcement of sinews moulded on to the back and probably concealed by an ornamental layer of some kind. In the higher forms of composite bow, one of the chief characteristics is the artful concealment of their composite structure beneath coats of bark and lacquer. From the expression, *νευρή*, we gather that the bow-string was of sinew, and we also learn that the bow of Odysseus was carefully kept in an ornamental case,[1] after the fashion of Asiatic archers using the composite bow. The few examples of bows composed of horn alone, existing at the present day, do not appear to be of very exceptional power, and certainly not of sufficient strength to resist the efforts of men trained to the use of this weapon, as were the suitors of Penelope.

There is no doubt that the Parthian, Dacian, and Scythian bows of antiquity were "composite" bows of somewhat similar structure to those of modern Persia or China, as we have evidence that the Persians derived the bow, which they afterwards brought to such perfection, from the Scythians. According to Rich[2] the Scythian bow was shaped in two bays, one smaller than the other, and resembling the early Greek Sigma Ϛ. Hercules is figured carrying an unequally curved bow of this kind, possibly representing the one which he obtained from Teutarus, a Scythian shepherd, as opposed to that which he received from Apollo, which was necessarily a "Greek" one, and symmetrical. The Scythian bow as usually represented is symmetrical and, in the unstrung state, regularly curved in a C shape, resembling the type most characteristic of modern Persia. The unequally curved bows may have been so made for the purpose of enabling the archer to draw the arrow in a line from the exact centre, or the bows may have been distorted in the representation.

To return to the bows of modern times.

Amongst the Chukches of Easternmost Siberia, as one would expect from the proximity to the shores of Alaska, the form of the bow bears a strong similarity to that of those of the Western Esquimaux. It appears from the narrative of the Vega Expedition that the modern Chukch bows are very degenerate and of inferior manufacture, though the older bows were of finer make. These were larger and made with greater care, "covered with birch bark and strengthened by an artistic plaiting of

"..... τόξον
ἀυτῷ γωρυτῷ, ὃς οἱ περίκειτο φαεινός."
Odyssey, xxi, 53.

[2] Dictionary of "Roman and Greek Antiquities."

sinews on the outer side." This birch bark covering is a strictly Asiatic characteristic, whereas the *plaited* sinew reinforcement is chiefly peculiar to North America. Further west, among the Tunguses, the bows shew a close relationship to the Tatar form, described below, both in general outline and in structure. A Tungus bow in the British Museum, of markedly "Tatar" form, is mainly built up of wood, a double layer running along the "arms," with a fairly thick reinforcement of sinew moulded closely along the back as far as the commencement of the straight "ears."[1]

The "backing" is entirely covered with thick birch bark, scored over with ornamental grooves and scratches. The "ears" are short and of solid pieces of wood, with small bone wedges let into the ends, to give strength to the nocks, which, oddly enough, are in this specimen situated at the extreme ends, and not just below the ends, as in most bows. The ridges below the "ears," so characteristic of the higher Southern forms, are here only slightly marked, the "ears" thickening rather suddenly. The "grip" is of wood, covered with birch bark, and bound at the centre with hide thongs. The belly is composed of a strip of horn along each "arm" reaching to the bases of the "ears," almost entirely exposed, except for a slight overlapping of bark round the edges. The horn is very thin indeed, and can hardly have been of great service in increasing the strength and elasticity of the weapon, and was probably added to this bow more for the purpose of carrying out the "Tatar" design, in spite of scarcity of suitable material, than for real use. The edges of this bow are finished off with bone strips, and there are bone bridges at the "elbows" for the bow-string.[2]

A second Siberian bow in the British Museum is from the Bashkirs, a nomadic tribe in the Ural district, in the govern-

[1] For convenience, I may here explain the terminology used:—

Back = The side which in most of these bows is concave when unstrung, becoming convex when strung.

Belly = The side opposite to the back, which is nearest to the archer when shooting.

Arms = The flexible portions lying between the central "grip" and the rigid extremities.

Shoulders = The points where the bow suddenly narrows laterally to form the terminal "ears."

Ears = The inflexible extremities beyond the arms, at the end of which are the nocks. They are usually termed the "horns," but in dealing with the anatomy of the composite bow an obvious confusion is avoided by substituting this word.

[2] Anuchin (*op. cit.*) describes the Tungus bow, from a specimen in the Moscow Museum, as made of two kinds of wood, fastened tightly with yellow (? inner) birch bark; on the back (*i.e.*, "belly") are fastened horn strips, except in the middle, where the bow is held for bending, and at the ends pieces of bone are attached, in which notches are made for the cord ends.

ment of Orenburg. This specimen exhibits the so-called "Cupid's bow" shape very strongly. It is roughly made. The wooden base is fairly thick along the "arms"; the sinew backing is powerful and covered with thick birch bark; the "back" is slightly concave in cross section, and the "belly" very convex. The horn layer on the "belly" is thicker than in the preceding specimen, but is thinned down towards the "ears"; it is entirely exposed, except at the "grip." The ridges below the "ears" are fairly marked and apparently shaped in the wood, and not by moulding the sinew; the "ears" short, with partial covering of bark, wound spirally round them; and the nocks are just below the extremities. At two points on the arms there are supplemental transverse bindings to keep the horn strips in place, but these have evidently been added since the bow was finished, and are for mending rather than part of the necessary structure. There are bridges at the elbows for the bow-string.

A bow described by Erman deserves mention here[1]: "A very powerful bow, also made of fir, is in use by the natives dwelling on the Northern Obi, and is stated to be the peculiar manufacture of the Kasuimski. The bow is strengthened by thin slices of the horn of the fossil rhinoceros, *R. tichorhinus*, very neatly joined to the fir by fish glue, and requires great dexterity to bend it fully. The Kasuimski are inhabitants of the banks of the Rivers Kas and Suim."[2] It is possible that fossil horn has been frequently used as a substitute for the more serviceable buffalo horn of the higher types.

Turning now to the bow known as the "Tatar" bow, which has given rise to the so-called "Kung"[3] bow of China, an advanced type is reached, and better workmanship displayed, than in any of the preceding examples. The backward curve when unstrung, and the "Cupid's bow" shape when strung, are strongly marked in this type. Externally it shows a thick and strong rounded layer of black horn lying along the belly, completely uncovered and extending to the base of the "ears." Each "arm" has a single piece of horn. The "ears" are bent down sharply at the "elbows," and are nearly straight; at the extremity of each a wedge of horn may be let in to strengthen the nocks, and the actual tip beyond the nocks may be entirely

[1] Quoted from Richardson's "Polar Regions," p. 308.

[2] These two rivers flow into the Yenesei in about latitude 60° N.

[3] "Kung," 弓 in Chinese, means any kind of bow, so that it cannot be used as an adjective to describe this particular form of bow. The word Nu, a cross-bow, becomes when written 弩, which is a combination of a phonetic character sounded Nu, and the radical Kung, which has been added in order to express the thing visibly, as meaning a bow of some sort.

I am indebted to Mr. F. H. Balfour for the above note.

of this horn, but in the commoner examples the occasional presence and desirability of this addition is indicated by painting the wood black beyond the nocks, thus giving the appearance of horn.

The back is covered with birch bark, applied in rhomboidal pieces, giving the appearance of a spiral winding. The bark extends as far as do the backing sinews, and completely conceals them. In the commoner specimens the bark is left in its natural state, but in finer examples, and especially in the better Chinese bows, it is covered wholly or partially with paint and with elaborate designs in thin cardboard stuck on to the surface and varnished over. Along the edges run narrow strips of horn or cane, which conceal much of the inner structure. The central grip is usually bound round transversely with sinews and in the better examples covered with thin cork or leather. The ridges are always well marked. The nocks are occasionally at the extreme tips as in the Tungus bow above. I dissected one of these bows, of the rather commoner sort, in order to show its structure more in detail. Plate VI, Figs. 4–8, refer to this specimen, and the description may, I think, be taken as fairly characteristic of all bows of this type.

Fig. 4 shows a tranverse section through the middle of one of the "arms." Along the centre runs a flat piéce of cane (a^1) of the same width nearly as the "arms"; to this, on the belly, is neatly and firmly glued a thick piece of horn (b), flat on the inner and convex on the outer side. On the back there lies firstly a layer of sinews (c^1), longitudinally disposed, partly mixed with glue, and adhering very closely to the cane; over this is a second layer (c^2) of mixed sinews and glue, the proportion of glue being greater in this than in the lower layer. These two layers are turned round the cane so as just to meet the horn at the sides, and here are seen the two thin strips of horn (d—d) which conceal externally the point of juncture of the several component materials. Over the second stratum of sinew is a layer (e) of fine, delicate inner bark of birch, overlying which is the external layer of coarser bark. The region at which this section has been cut is that where the greatest flexibility is required, and where the bow is flattest and widest, though in this type the width does not vary greatly along the "arms."

Fig. 5 is taken from a *dissection* of the same part showing the succession of the layers, a portion of each layer being removed to display the one lying immediately below. The letters correspond with those in Fig. 4.

Fig. 6 shows a tranverse section taken at the sudden bend or "elbow," which indicates the commencement of the "ear." In this region there is a prominent ridge which gradually rises and

shades off into the "ear." In the section it is seen that the cane is replaced by hard wood (a^2) with a triangular cross section which produces the shape of the ridge. Over the "belly" side lies the horn, very thin at this point; it terminates a little way beyond this point. On the back are seen the continuations of the two sinew layers c^1, c^2. The external bark layers are the same as before.

In Fig. 7 is seen a transverse section through the centre of the handle or "grip." Here the centre is composed of both cane and hardwood; the cane a^1 is in direct continuation from the "arms"; the hardwood serves to pad out the handle in order to fit the grip comfortably. The horn, *b*, is very convex here, and this section cuts through the point of meeting of the two horn strips, which together cover the belly as far as the "elbows"; so that here the end of one of the pieces is represented. The longitudinal sinews are disposed as before. The bark does not extend over the handle, but, as mentioned above, in its place there are coarse sinews, *g*, wound transversely round in a slightly spiral manner, the ends of which are seen cut across in the section. In the more elaborate specimens there is a layer of shark skin, covering the grip, with thin cork overlying the whole, and affording a good hand-hold.

Fig. 8 is taken from a longitudinal section through the whole of the grip, and shows on a reduced scale the extent and form of the plug of hardwood, a^2, and how it ekes out the shape of the hand-hold; the meeting of the two horn strips, *b*, *b*, is also seen.

The specimen from which the above description is taken is by no means a fine specimen of its kind, but may be taken as fairly typical of the "Tatar" variety, as the different examples seem to vary more in external finish than in internal structure.

The figures of the complete Persian bow (Plate VI, Fig. 9), and the anatomy of another specimen (Figs. 10–16) are taken from specimens sent to the Oxford Museum, by Colonel Sir R. Murdoch Smith. The two specimens are exactly similar, so that the description of the structure of the one may be taken as applying to that of the other, which is figured entire.

These specimens are estimated by Colonel Murdoch Smith to be certainly 200 years old, and are very good examples of the highest type of composite bow. It is highly improbable that this weapon will ever improve, with the increasing use of fire-arms in Asia, and we are justified in regarding this as the culminating point in the series.

In shape this bow (Fig. 9) differs from the "Tatar" bow; the unstrung curve is more regular and resembles that of the Scythian bow as generally described, and the "ears," which are relatively much shorter, continue in the same curve with the

"arms"; they are moreover not bare, but overlaid with sinew as far as the nocks. The "arms" also, as compared with the "Tatar" bow, are proportionately flatter, wider at the centre, and more tapered towards the "ears" and "grip"; and they are further more markedly plano-convex in section. The specimen figured does not exhibit the recurving in the unstrung state, to the extent of many examples, in some of which the tips actually cross one another.

As the scale is ascended the tendency to conceal the structural details beneath an external coat, and thus to give an homogeneous appearance to the bow, becomes increased. We observe it in its infancy in the Siberian bows with their plain or very slightly ornamented bark covering, lying over the sinew backing; and higher in the scale this coating, which at first doubtless served a purely *useful* purpose, as a protection from the effects of weather, becomes more and more a vehicle for the embellishment of ornamental art, at the same time increasing in its extent, till the maximum is reached in bows of the Persian type, in which usually the elaborate structure is entirely concealed by a coat of lacquer, upon which frequently great artistic skill is lavished in floral designs and scroll work picked out in gold. All composite bows appear to require soaking in water to produce their maximum effect, and possibly this bark coat, besides protecting the sinews from injury, was intended primarily to prevent rapid change in the condition of the bow, and especially the sinew and glue, from changes in the temperature, and to protect them from the sun's rays. *Secondarily,* it was found to be a convenient ground upon which to lay the varnish and paint which give the finishing touches. I do not know the composition of the lacquer used, but it must doubtless be of a very special nature not to crack all over when the bow is bent.

The specimens figured are, as appears to be usually the case with the Persian bows, entirely covered with the lacquer coat, except at the edges of the arms, where the side strips of horn appear on the surface, as in most specimens where they occur at all.

A section (Fig. 10) taken transversely across the centre of one of the arms, at once exhibits a marked difference from the corresponding section in the Tatar bow (Fig. 4). It is seen that the centre (*a*, *a*) is composed of a light-coloured wood in two pieces, unequal in width, and the surface of this is much scored with rough grooves, to give a firm hold to the glue and sinews. The belly is composed of a number of narrow strips of horn (*b*, *b*) instead of a single piece. These are joined to the wood and to each other with glue, which is seen filling up the interstices as an hyaline substance (*h*). Over the horn strips is a very thin

layer of transversely disposed sinews mixed with glue, extending from side to side, and apparently to assist in keeping together the numerous strips. This does not occur in the "Tatar" bow. The back is covered with a thick layer (*c*) of longitudinal sinews, slightly mixed with glue, the layer being well coated on the outside with glue, the surface of which is smoothed and polished. The sinew layer appears to be single and not in two strata, as in the "Tatar" bow. Overlying *both* belly and back is a layer of the finest inner bark of the birch, very delicate, and applied in rhomboidal pieces, as before described (there is no layer of coarser bark), and immediately upon this lies the external coat of lacquer. At the edges the strips of horn (*d*, *d*) are exposed and break the seemingly spiral winding of the bark, which is only apparent, as the edges of the pieces on the back and belly do not correspond.

Fig. 11, Plate VI, is taken from a dissection of the belly side of this part, shewing the successive strata—the horn strips (*b*, *b*); the external side strips (*d*, *d*); the transverse sinews (*k*); the bark layer (*e*, *e*), shewing portions of two pieces; the external lacquer (*l*), which replaces the bark coat (*f*), of the "Tatar" bow. A dissection of the back is shown in Fig. 12, where *c* represents the sinew reinforcement, and c^2 the external surface of this, coated with smooth polished glue.

Fig. 13 shews a transverse section through the middle of the ridge at the commencement of the terminal "ear," corresponding to Fig. 6. The number of horn strips is smaller than at the centre of the arm, shewing that these do not all run the whole length of the arms; the horn ends abruptly at the commencement of the "ears," about three inches beyond the point at which this section is taken. It is also seen that in the Persian bow the wood base enters less into the formation of the ridge than is the case in the "Tatar" form; the ridge is here almost entirely moulded up from the sinew mass.

A transverse section (Fig. 14) through one of the "ears" shows the hardwood base split up into four pieces, *a*, *a*, *a*, *a*. The two smaller pieces commence at the point where the horn ends, and take its place. A new element appears in a flat piece of horn *m*, running down the centre, at right angles to the faces of the bow. This is a thin horn wedge, thickest at the extremity beyond the nock, to which it gives support. It resembles the similar piece in a Chinese bow in its use, but differs in its traversing the whole length of the "ear," and in never entirely forming the extreme tip beyond the nock. The longitudinal sinews, *c*, *c*, surrounding the "ear" are in continuation of the longitudinal backing sinews, which are here brought round in two bands, completely encasing the wood, being only separated

from each other by the edges of the thin horn wedge, which are seen externally. Below the nock is a band of transverse sinews, binding together the elements composing the "ear." There is no layer of bark over the "ears," the lacquer and gilt being applied directly to the sinew.

Fig. 15 is taken from a transverse section through the centre of the handle or grip, corresponding to Fig. 7: a^1 and a^2 are two pieces of hardwood forming the base, the smaller piece being inserted to pad out the grip and to give it a rounded form; the two are glued together. The number of horn strips which reach this point is reduced to four, as this portion is narrowed considerably. This section does not cut through the point of junction of the two sets of horn strips, for, as will be seen from Fig. 16, the meeting point is not exactly at the centre in this specimen. The sinew backing extends nearly round the grip, omitting only the portion where lie the horn strips, overlying which is a thin layer of tranverse sinews, as elsewhere. The shape is partly moulded from the sinew mass, as it is in the ridges (Fig. 13). The bark covering entirely surrounds this part, as the side strips of horn do not extend along the grip.

In the longitudinal section through the grip (Fig. 16), is seen the extent of the small pad of hardwood, a^2, and the meeting point of the two sets of horn strips, between the ends of which is inserted a thin strip of wood. The principal piece of wood in the grip, a^1, continues in either direction a short distance along the arms in the form of a wedge, pushing its way between the pieces which form the centre of the arms, which are represented in Fig. 10, *a*, *a*.

In the figure of the perfect Persian bow the points at which the transverse sections have been cut are indicated with dotted lines.

Hansard in his "Book of Archery," quoting Thevenot, says, "Oriental bowyers use a peculiar kind of glue, made from a root called in Turkey 'Sherischoan,' which they grind like corn between two stones, until it resembles sawdust." It is certainly a most effective kind of glue, as it does not appear to crack with use, though it sets very firmly; it is also very pellucid.

Murdoch Smith[1] says of these bows that, after leaving the maker's hands, in order to be strung for use, they had first to be softened in a bath, and then gradually opened by cords attached to pegs in the ground.

Although the finer Indian bows are of a high type, they hardly attain to the level of the typical Persian bow, and many of them shew signs of a slight degeneration from a higher type. They are closely related to the Persian and Turkish types.

[1] "Persian Arts." South Kensington Museum Handbook.

The specimen of an Indian bow which I have dissected and figured (Figs. 17–21, Plate V) is very strongly recurved in the unstrung state; each arm for a third of its length is curved sharply at right angles to the rest, which is only slightly curved, thus forming a marked rounded elbow. It is rather less powerful than the Persian bow described, being less stoutly made and of weaker materials. In external appearance it shows a strong resemblance to the Persian bow; the ears are shorter and the shoulders more pronounced, these being very square. It is entirely covered externally with a thin lacquer coat, differing in appearance from that of most bows of this or the Persian types; this appears to be due to the fact of its lying not on bark, but on a peculiar metallic layer resembling tinfoil, but infinitesimally thin, and perhaps painted on from a solution. It gives a hard appearance to the overlying lacquer. There is no trace of side strips of horn along the edges of the arms. The nocks are not, in this specimen, strengthened with horn.

On examining the structural details by means of sections, many departures from the Persian type are observable.

To take a transverse section through the centre and broadest part of one of the arms (Fig. 17), it will be at once seen that the horn here plays a far less important part than in either the Persian or Tatar types. The belly is not entirely composed of this substance, as in the latter types. The wood centre (*a*) is composed of a single piece along the arms; this is deeply and neatly grooved longitudinally towards the belly, in order to give firm hold to the glue, which forms a fairly thick layer (*h*) between the wood and the horn. The horn (*b*) is composed of a single piece in each arm, and not composed of strips as in the Persian bow; its surface is grooved towards the wood. The horn does not extend to the edges, but is overlaid with a stratum of longitudinally disposed sinews, similar to those on the back, and apparently a continuation of them. The sinews are in a double layer; one layer, n^1, composed of sinews with little glue mixed with them, does not extend *over* the horn, but fills up the space between it and the edges; this is a continuation of the inner layer of the back, c^1. The outer layer, n^2, overlies both horn and inner sinew layer, n^1. The shape of the belly is thus to a great extent given by a padding out of sinews. The outer sinew layer, n^2, is mixed with glue or cement, and has a dull grey brown colour; this is coated with a kind of red brown cement, the surface of which is smoothed. Over this brown cement lies the peculiar thin metallic film, which is extremely delicate, and it is difficult to prevent its rubbing off when exposed. To this is applied the external ornamental lacquer coat. It is not easy to account for the substitution of the

metallic layer for the bark one, as it seems to be but an indifferent vehicle for the lacquer, which flakes away from it rather easily. The external sinew layer of the back, c^2, differs from that on the belly in being only slightly mixed with glue and having none of the grey brown cement.

Fig. 18 shows a dissection of the belly of this part, displaying the succession of the layers, a = the wood; h = the glue; b = the horn; n^2, the outer sinews mixed with grey cement; o, the brown cement; l, the lacquer.

A dissection of the back is represented in Fig. 19; p is the metallic film.

Fig. 20 is taken from a transverse section through the centre of one of the ridges. The wood centre is seen here to be composed of three strips, a^1, a^2, a^3, of which the centre piece, a^1, enters largely into the formation of the ridge, and is a wedge-shaped continuation of the "ear," which fits between two divided ends of the single piece forming the arms. The extremities of these double ends form the shoulders. The horn has dwindled down to very small proportions, as it is thinned away as it approaches the shoulder, and adds but little support to this part. This reminds one of the "Tatar" bow, and shows divergence from the Persian types; but this specimen differs from both types in the belly at this point being chiefly built up of sinews and cement. Beyond the "shoulder" the "ear" is formed of a single piece of wood, but a layer of sinews encases it as far as the nocks. The actual tips are painted black, as though intended to represent horn.

A transverse section through the centre of the "grip" (Fig. 21), shows that the bulk of this portion is composed of a single piece of wood, a, the horn, however, playing a fairly important part. Round the whole lies the inner layer of sinews, here evidently perfectly continuous all round, c^1, n^1; and over this on the back the outer sinew layer, c^2, and on the belly the layer of sinew and grey cement as before, the two different layers meeting at the sides and overlapping one another slightly. This double sinew casing is of an equal thickness all round, and the shape of the grip is formed by the wood and horn. The central piece of wood is continued wedge-like into the arms, tapering at either end and fitting into a V, formed by the divided end of the wood of the arms. Represented diagrammatically the woodwork of the whole is arranged thus; rather more than one half of the bow being represented.

b

The two strips of horn do not meet in the centre, but, as in the Persian bow above, a little away from this point.

The more prominent structural peculiarities of this type then, are:—(1) The small proportion of horn in its construction; (2) the presence of layers of longitudinal sinews on the belly, replacing to a great extent the horn; (3) structure of the wood base; (4) the absence of a layer of bark and the presence of cement and metallic coat; (5) the absence of side strips of horn.

It shows resemblance with the "Tatar" type in the sudden bend at the elbows; in the formation of the ridges chiefly from the wood centre; in the *single* strip of horn in each arm; in the *double* layer of backing sinews; in the thinness of the horn towards the "ears." It resembles the Persian type in the general moulding of the shape of the different parts; to a certain extent in the structure of the wood base; in the *entire* concealment of structure beneath an ornamental coat.

There is evidence that this form is, to a certain extent, a degenerate offshoot from a higher type, *e.g.*, the comparative weakness of the whole, and also the weakness of certain parts. This latter is indicated in very many examples by rough external bindings or splicings at the elbows and on either side of the grip, added in order to assist these parts to stand the severe strain. Sometimes these splicings have been added after the completion of the bow, as the lacquer coat has been first completed over these parts, and it seems as though the weapon had been discovered to be weak after use. In other cases it has been applied in the first instance, as a finishing touch; the lacquer having been omitted at the parts where the splicing was intended to be added. Fig. 22, taken from a specimen in the Pitt Rivers collection, shows one of these bows spliced in this fashion; it recalls the similar cross splicing at the elbows of most Western Esquimaux bows.

Another possible sign of degeneration is the absence of the side strips of horn along the edges. These, however, are frequently imitated by means of lines of black paint, thus indicating the desirability and former presence of the real material. Their absence is due to the continuation of the sinews round to the belly, thus leaving no edges to be concealed and finished off; but as this is so at the expense of the horn reinforcement, and so also of the strength of the weapon, it cannot be regarded as a mark of progress.

Again, the substitution of other materials for the bark layer as a vehicle for the ornamental lacquer does not, judging from this specimen, appear to be a success.

The Indian bows vary to a considerable extent in form and in external appearance, but, so far as I have been able to see

from superficial examination, the greater number do not differ materially in structure from the specimen described, which may be taken as fairly typical of the class. Many approach more nearly to the Persian type, and bark is often present beneath the lacquer.

I have not been able to examine a number of Turkish bows, but I gather that they are for the most part only slight modifications of the type of which the Persian and Indian bows are varieties.[1] A bow in the British Museum, described as Turkish, is small and very beautifully finished. Its length is 3 ft. 8½ in., and greatest width 1⅕ inches. The grip is covered with bark, and bulges towards the back only; the horn of the belly is exposed and polished, thus reminding one of the "Tatar" type; it is in two pieces, separated at the centre of the grip by a thin ivory plate. The sinew backing is covered with thin black leather, upon which designs are picked out in gold. The ridges are strongly marked, and the "ears" of plain wood and very short, partly covered on the back with birch bark. The nocks are lined with leather. In transverse section the arms are plano-convex. It is very powerful for its size; the reflex curve is very regular and increased gradually towards the "ears," resembling the curve of most Persian bows. Of the internal structure I am unable to speak.

I have confined myself in the above remarks to the class of weapons which goes by the name of the "composite bow," that is, bows which have a reinforcement of sinews on the back, and which in many cases exhibit further a composite structure, in the presence of a variety of materials. There are, however, a few forms which, although they must be excluded from this class, nevertheless show a relationship to the composite type, and give evidence that they have been derived from it.

Many plain wood bows from the Oregon Indians have a strong reflex curve when unstrung, though this is not due to the presence of sinews on the back, the curve being *carved* to shape in the wood itself. They are very flat, short, and springy, and in general character suggest relationship to bows of composite nature. Besides these, most of the bows of the Clapet tribe show a similar relationship. These again are plain or "self" bows, but in their strongly plano-convex or concavo-convex section seem to point to the aforesaid origin. They are moreover characterized by having broad grooves along the back, which may be considered as possibly imitating a former sinew backing, or even as being channels along which a sinew cord

[1] "The composite bow was held in great esteem with the Arabs and Turks, in whose language are many words for different bows, the parts of them, and the discharging of them." Anuchin, *op. cit.*

used formerly to lie, though now disused and merely retained from force of habit.

In Java we find a bow which is peculiar to the island. It is composed of two arms each consisting of a single piece of horn, usually of black buffalo horn, meeting at the centre, where they are fixed into a large rounded wooden handle, composed of two pieces, joined at top and bottom with a metal ferule. The horn is plain and smooth, in section plano-convex; in the unstrung state there is a strong reflex curve; the nocks are deep and the extremities laterally flattened, and there are ridges below the nocks. From these characters it would seem as though the Javanese bowyers had originally had the Asiatic composite bow in view. This being so, one can understand that the material (horn), which alone is exposed to view in the Asiatic model, suggested the use of that substance for the construction of the whole. Raffles, in his history of Java, tells us that these bows ("Gendewa") are seldom used in modern days, except on state occasions. Perhaps I may be allowed here to digress a little in order to mention a somewhat interesting fact which lately came under my notice. Dr. Hickson, on his return from the Malay Archipelago, showed me, amongst other specimens, a bow which had been obtained from New Guinea. This, however, proved to be a perfectly characteristic Javan bow, such as I have described, which had somehow found its way eastward to a region where its proper use was not appreciated. The strongly recurved outline of the bow, when unstrung, does not appear to have suggested its *raison d'être* to the mind of the savage into whose hands the weapon fell, as he adapted the bow to his own use by adding a bow-string of rattan, ingeniously fixed on the wrong side. He thus made the *reflex* curve that of the strung bow, and in this way contrived to minimize the power of the weapon. Moreover the shape of the nocks is not adapted for a flat rattan string, which in this case does not present its flat surface towards the bow, as in all New Guinea bows, but edgewise, in a highly ineffective position. This serves perhaps to emphasize the intimate connection between this reversed curve and composite structure, and to strengthen the idea that the Oregon bows, above mentioned, are copied from composite bows. It is unusual to find a recurved outline in, so to speak, "pure bred" self bows of savage races.

Another kind of bow, which shows a relationship to the "composite bow," is that described as formerly in use in Lapland. This weapon has entirely vanished in these parts, and was apparently obsolete at the time of Linnaeus' visit in 1732; it has succumbed entirely before the inroad of fire arms, although these are for the most part of very primitive type; most

of the rifles that I saw among the Lapps during a short visit last summer to East Finmarken, were modern reproductions of the antiquated "snaphaunce." I cannot do better than reproduce the description given by Jean Scheffer[1] of these bows; he says, "La première arme et la plus en usage sont les arcs, qui sont long d'environ trois aunes, larges de deux doights, épais de la grosseur du pouce ou d'un peu plus, faits de deux bâtons, qu'ils attachent l'un sur l'autre. Car ils mettent sur un bâton de Bouleau un autre bâton de Pin, qui par l'abbondance de la resine est doux et facile à plier, afin que ses qualités donnent à l'arc la force de pousser bien loin les dards et les flèches; et ils les couvrent tous deux d'ecorce de Bouleau, pour les conserver contre les injures de l'air, des néges, et de la pluie, . . . j'ajoûte qu'elles sont collées ensemble avec une espece de glu. Les Lapons preparent et font ainsi cette glu. Ils prennent des poissons que l'on nomme perches, dont ils ostent la peau, etant encore fraichement peschées, ils les tiennent dans de l'eau chaude, jusqu' à ce qu'on les puisse netteier de toutes leurs écailles, puis ils les font cuire dans un peu d'eau, et ont soin de les écumer, de les remuer souvent, de les battre avec un petit bâton, et de les consumer jusqu' à ce qu'elles ne resemblent plus estre que du bouillon; ils repondent cette liqueur épaisse en un lieu où elle se durcit, et la conservent pour le besoin, et quand il faut coller quelque chose, ils la font dissoudre dans un peu d'eau. . . ." This bow is composite to the extent of being composed of two kinds of wood, but no sinew reinforcements seems to have been added, and this weapon must be regarded as a variety of the plain bow, though showing the influence of the proximity of bows of strictly "composite" type to a very considerable extent. It is said that the Lapp bow resembled in shape the "Tatar" form, and Scheffer's figure bears out this statement; the presence, moreover, of a covering of birch bark betrays a connection with the more easterly types. The bark in this bow, as in the Siberian bows, appears to have served a purely useful purpose, without being used as a vehicle for embellishment. General Pitt Rivers mentions that these bows were held horizontally, in shooting, like those of the Esquimaux.[2]

The practice of combining two kinds of wood, *i.e.* forming "backed" as opposed to "self" bows, became very popular in

[1] "Histoire de la Laponie," traduite du Latin de Jean Scheffer. 1678.

[2] Anuchin mentions both fish glue and stag's (reindeer) glue as used in making these bows, which are sometimes as much as six feet long. He also says that they are commonly still met with amongst the Voguls. Later he says, "The Finn bows in all probability were composite, as now amongst the Voguls and Ostiaks."

England, when introduced from France, and has continued to the present day. Usually a thin strip of ash, elm, or hickory was glued upon the back of a yew bow, when the best quality of the latter wood was not obtainable. Occasionally the two pieces were ingeniously united together by a groove and dovetail throughout their length. These bows must, however, be regarded as varieties of the "arcus" or plain bow, and not related to the "composite" bow.

Steel bows have been made in imitation of composite bows of Asiatic origin. Anuchin says, "Composite bows from the Greeks spread to Italy in the XV and XVI centuries, where their form was imitated in bows made of steel, as also in India and other Eastern parts."

One more kind of bow deserves mention, as particularly interesting from the locality in which it is found. W. M. Moseley, in his "Essay on Archery," says, "The Otaheite bows are very long, and consist of one piece only, on the back part of which there is a groove containing a pretty thick cord. The cord reaches the whole length, and is fastened very strongly at each end. This contrivance is found very serviceable in assisting the strength of the bow, and acts in some measure as a spring." He also compares this to the sinew backing of the Esquimaux. I have never seen a specimen of a South Pacific bow reinforced with a cord in this way, but this passage seems to offer a far more rational explanation of the groove, which forms so characteristic a feature in the bows from the Tongan group, than that given by Captain Cook,[1] who says of them, "On the inside is the groove in which is put the arrow, from which it would seem that they use but one." Very likely this may have been a *secondary* use of the groove; Cook in fact figures an arrow *in situ*, but then this could hardly have been sufficiently desirable to have *given rise* to the groove. The ends of most Tongan bows are carved to form slightly raised channels, whose hollows are in continuation with the groove along the backs of the bows, *see* Fig. 23; the outer ends of these raised channels form the shoulders upon which the bow-string rests when the bow is strung. The form of these channels, and their continuation into a groove along the back of the bow, is very suggestive of their having been intended for a cord to lie along, the groove being necessary in order to prevent the cord slipping away when the bow was bent. The cord could have been wound round the shoulders in the same way as the bow-string. The groove along the back varies very much in depth in different specimens, in some being deep enough to contain an arrow, while in others it is very slightly marked indeed and incapable

[1] "Cook's Voyage, 1772-75," Vol. i, p. 221, and plate.

of serving a useful purpose. Possibly, in the case of these latter, when the cord reinforcement went out of use, and the deep groove became no longer necessary, the latter was still from force of habit carved along the back, though far less deeply, in some specimens being a mere narrow indented line; the raised channels in some specimens no longer exist. I do not know of any Otaheitan bows which have grooves, or which appear to be intended to be used with a "backing" cord, but it is possible that the bows which Moseley described as from Otaheite were really bows of this Tongan form, and perhaps from that group of islands. This form of reinforcement must have been independently evolved in the South Pacific, as the only other races using a "free" backing are restricted to North America and the easternmost parts of North Asia. The case should therefore be regarded as one of analogy rather than of homology. Bows from Guiana and Peru frequently have a groove or furrow running along the back, often fairly deep, and the Chunchos of Peru are said to insert a spare arrow into the groove and hold it there with the bow hand. There is no evidence, so far as I know, of a cord reinforcement being used in South America (though it is common to see bows with a spare bow-string fastened to them). This may appear to go against my remarks in the case of the Tongan bows, as we have in South America bows in which a groove is used solely for the insertion of an arrow, with no record of its having been otherwise used; but I think that nevertheless the fact of there being specimens of reinforced bows on record from the South Pacific, coupled with the very specialized form of the groove in many of the Tongan bows, gives support to my suggestion.[1]

In seeking for the original home and birth-place of the composite bow, the mass of evidence seems to refer us to some part of North Central Asia,[2] possibly the more northerly regions of the ancient Scythia, where the absence of wood suited to the making of "plain" bows created the necessity of employing a combination of heterogeneous materials, in the attempt to imitate the bows of other people. There is strong evidence, as General Pitt Rivers points out, that this scarcity of proper wood extended further to the southward in prehistoric times than is the case now.

[1] The custom of holding arrows in the *bow* hand when shooting, is common to several races, *e.g.*, South America, Ancient Mexico, amongst the Negritos. This is also seen in representations of archers on ancient Greek and Etruscan vases, as also of Norman archers on the Bayeux tapestry. *Vide* Anuchin, *op. cit.*

[2] Anuchin (*op. cit.*) says, "Taking into consideration the wide spread of the composite bow in North and Central Asia, and in Eastern Europe, we are led to think that it was invented somewhere within the limits of that region, and spread itself thence from a single centre over the East into North America, and over the West.

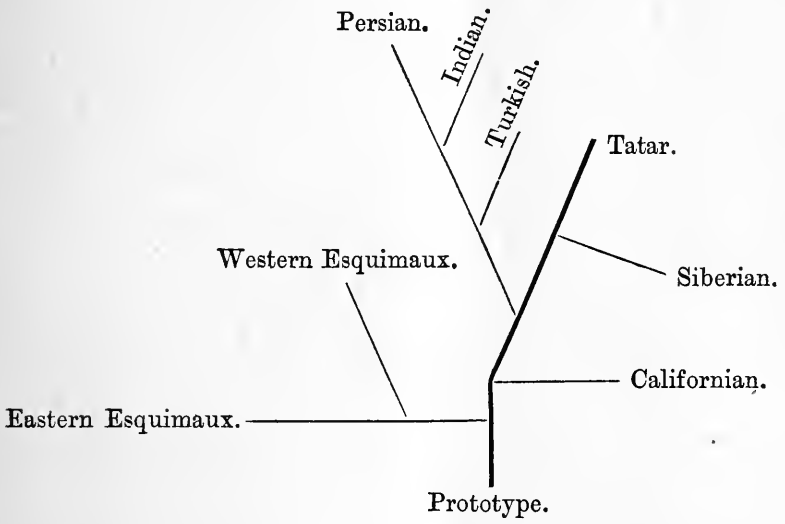
It is impossible to say whether the "free" backed bows, of which those of the Esquimaux are survivals, were really the earliest, and that this was the most primitive method used in reinforcing the bows. This kind, if it ever existed there, has entirely disappeared in Central Asia; but when we consider that all northerly races, from Lapland across Asia and America to Greenland, employ the sinews of animals constantly in the form of twisted thread or plaited cords for a variety of purposes; whereas *moulded* masses of sinews are, to say the least, but rarely employed, we can see that there is great probability that the earliest way in which sinews were employed for backing bows, was in the form of twisted or plaited cords rather than of masses. If this be so we must consider that the introduction of the bow amongst the Esquimaux took place at a remote period, and that these have existed in this state to the present day, chiefly on account of the isolation of these parts; though in the westerly regions the bows of the Esquimaux shew that they have been influenced, in shape at least, by the proximity to the Asiatic continent, and that for the same reason, as well as because of the access to better materials, these bows have been greatly improved and altered from the primitive type, which to a certain extent is represented by the Eastern Esquimaux examples.

Its spread from the place of origin to other parts of the world, gave in some cases a new weapon to nations which could never have used the earlier "self" bow, whereas in other cases its introduction amongst fresh races must have been subsequent to its having reached some degree of perfection, as it ousted the "self" bow then in use, and became recognized as a superior weapon. Thus by its spread in a northerly and easterly direction, across the Behring Sea, the Esquimaux became possessed of a weapon hitherto unknown to them; and so also in the case of Siberia, where it is very improbable that the natives made use of a plain wood bow. When introduced by the Mongols into China it supplanted the "plain" bow, which already existed there. General Pitt Rivers mentions that the "kung" bow was not the original bow of the country, but was introduced by the Tatars. It spread into India from the north, and here again the indigenous "long" bow has given way before its composite rival, and only the uncivilized aborigines of the north retain the use of the former, though it has held its own in South India and Ceylon.

We know that the Persians owe this weapon to the Scythians, as Herodotus tells us that Cyaxares, King of the Medes, and great grandfather of Cyrus, among other important military reforms, adopted the bow as a military weapon, having learnt the use of it during his wars with the Massagetae, Scythians,

and other races. He even kept certain Scythian archers to teach his son Astyages to shoot. Cyaxares died B.C. 594, but the bow remained in use and became a national weapon, and a figure of it a national emblem. Persian bows remained celebrated to the eighteenth century.

It is not easy to represent the probable affinities of the different existing varieties of the composite bow in the form of a genealogical tree, but I give here a rough scheme, which seems to me to illustrate broadly the lines of connection of the leading modern types.



I have aimed in my paper at giving an account of the comparative anatomy of the composite bow, in order to illustrate the structure and affinities of the chief varieties. I regret that I have had so little material at my command, as the dissection of a larger number of varieties would no doubt contribute largely towards establishing the lines of connection between the types and their modes of derivation from earlier forms. Without the assistance of a "geological record" and "embryological" evidence, which so materially assist the animal and vegetable morphologist, in tracing the history of such an object as the composite bow, the anthropological comparative anatomist is obliged to be content with observations made upon the "recent" and "adult" weapon, and thus the number of his clues is considerably limited.

Description of Plates V. and VI.

Fig. 1. Bow with simple form of "free" sinew backing; Eastern Esquimaux. Obtained by Capt. Lyon. Ashmolean Museum collection.

Fig. 2. Bow with more advanced type of "free" sinew backing, and shewing the "Tatar" outline. Western Esquimaux, near Icy Cape. Obtained by Capt. Beechey. Ashmolean Museum collection.

Fig. 3. Bow with simple form of "close" sinew backing, California. Obtained by Capt. Belcher. Pitt-Rivers collection.

Figs. 4–8. Chinese bow of "Tatar" shape.

Fig. 4. Transverse section through the centre of one of the "arms."

Fig. 5. Dissection of the back at the same part.

Fig. 6. Transverse section through the centre of one of the "ridges."

Fig. 7. Transverse section through the centre of the "grip."

Fig. 8. Longitudinal section through the "grip."

a^1. Wood base extending along "arms" and "grip."

a^2. Hardwood forming the "ears" and "ridges," and inserted as a plug to pad out the grip.

b. Horn, a single piece to each arm.

c^1. Inner layer of backing sinews.

c^2. Outer „ „ „

d. Side strips of horn.

e. Layer of fine inner bark of the birch.

f. Coarser outer bark.

g. Coarse transverse sinews round the grip.

Fig. 9. Persian bow, dotted lines indicate the points at which transverse sections have been taken in the following specimen.

Figs. 10–16. Persian Bow.

Fig. 10. Transverse section through centre of one of the arms.

Fig. 11. Dissection of the belly at the same part.

Fig. 12. Dissection of the back at the same part.

Fig. 13. Transverse section through the centre of one of the ridges.

Fig. 14. Transverse section through one of the "ears."

Fig. 15. Transverse section through the centre of the grip.

Fig. 16. Longitudinal section through the grip.

a. Hardwood base.

a^2. Plug of hardwood inserted into "grip."

b. Strips of horn.

Fig. 1.

Fig. 2.

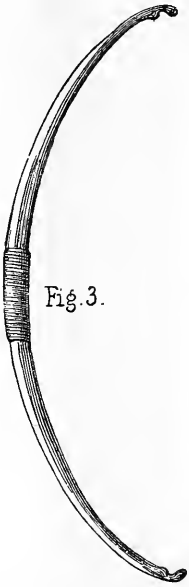


Fig. 3.

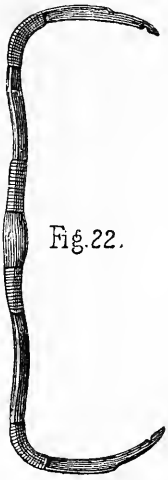


Fig. 22.

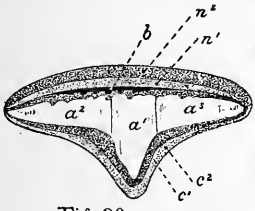


Fig. 20.

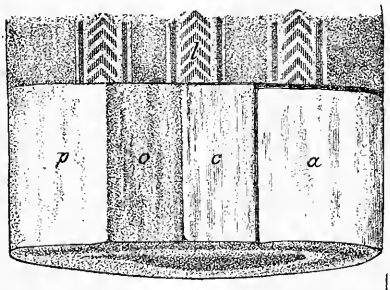


Fig. 19.

Fig. 23.

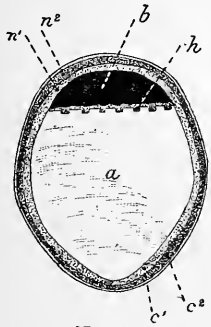


Fig. 21.

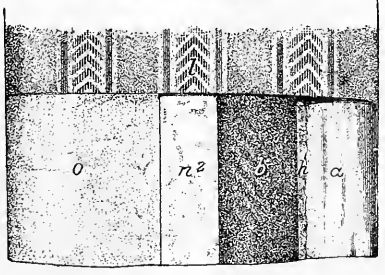


Fig. 18.

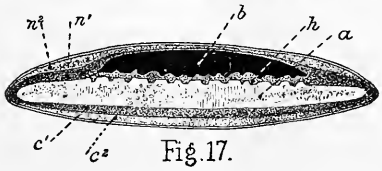


Fig. 17.

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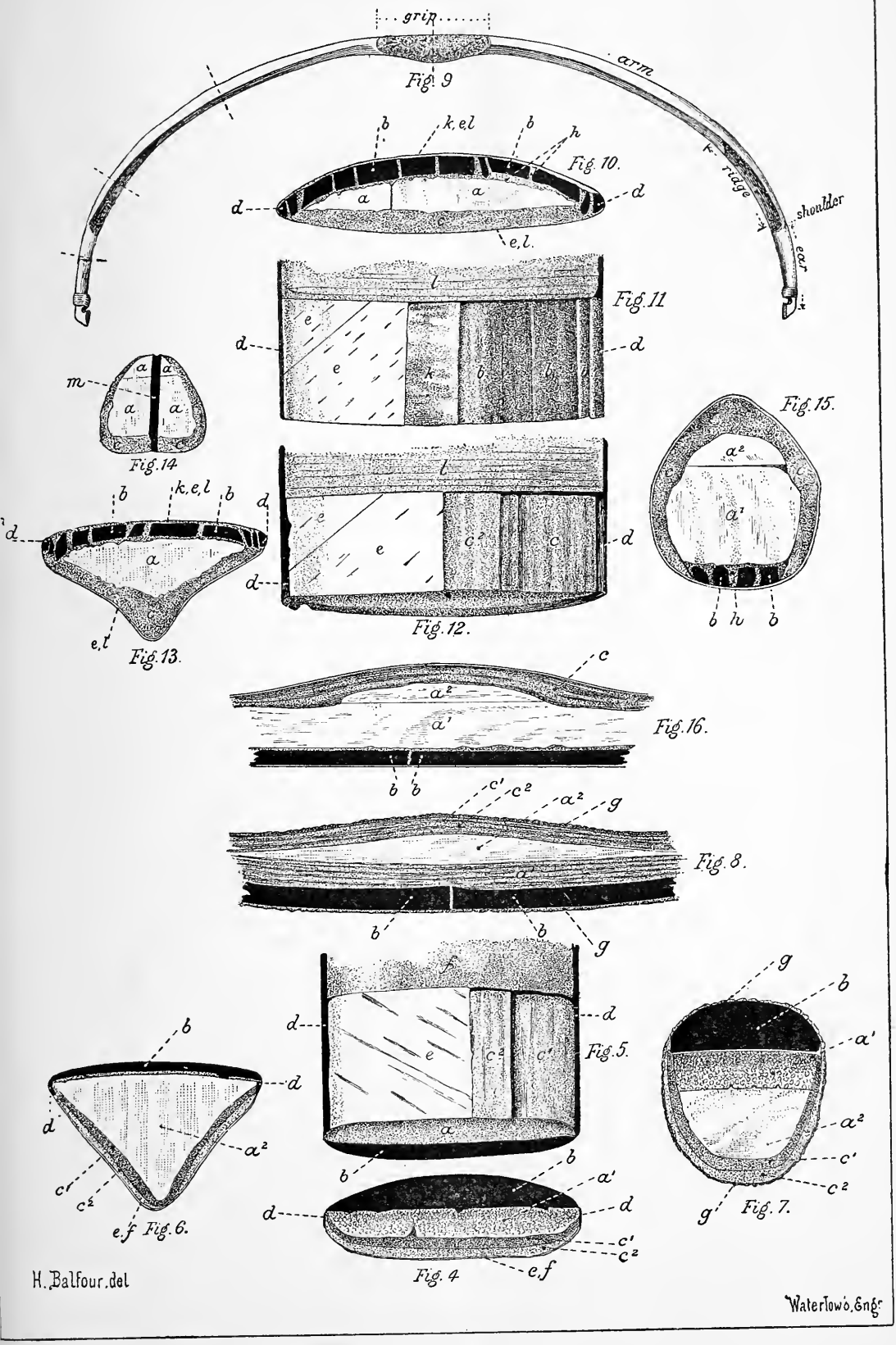
STRUCTURE OF THE COMPOSITE BOW.



STRUCTURE OF THE COMPOSITE BOW.

c. Sinew backing.
d. Side strips of horn.
e. Layer of very fine inner bark of birch.
h. Glue.
k. Transverse sinews over the horn on the belly.
l. Lacquer coat.
m. Piece of horn, supporting the "ears" and "nocks."

Figs. 17–21. Indian Bow.

Fig. 17. Transverse section through the centre of one of the arms.

Fig. 18. Dissection of the belly at the same part.

Fig. 19. Dissection of the back at the same part.

Fig. 20. Transverse section through the centre of one of the ridges.

Fig. 21. Transverse section through the centre of the "grip."
a. Hardwood base.
b. Horn, a single piece in each "arm."
c^1 and c^2. Inner and outer layers of sinews on the back.
h. Glue.
l. External lacquer coat.
n^1. Layer of longitudinal sinews on the belly.
n^2. Layer of grey brown cement-like substance, mixed with sinews.
o. Red brown cement coating.
p. Metallic film upon which the lacquer lies.

Fig. 22. Indian bow, probably from the Punjâb, shewing supplementary transverse splicing of sinews at the "elbows" and on either side of the "grip." Pitt-Rivers collection.

Fig. 23. One end of a plain wood bow from the Tongan Group, shewing the raised channel and part of the groove. Pitt-Rivers collection.

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